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**STROKE PREVENTION:  
A Continuing Quality Improvement Project**

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## **STROKE PREVENTION** **A Continuing Quality Improvement Project**

### **ABSTRACT**

**Background:** Stroke is associated with significant morbidity, mortality and cost. Therefore, it is important for primary care physicians to identify patients at risk for stroke and appropriately intervene.

**Methods:** At the Family Medicine Center, an ambulatory family practice residency clinic, a Continuing Quality Improvement (CQI) project was initiated to assess those patients at risk for stroke. This was accomplished by chart review of active patients, 55 years of age and older, for known risk factors for stroke, and by summarizing recent data on the prevention of stroke.

**Results:** Among the 2500 active patients at the Family Medicine Center, there are 147 between the ages of 55 and 94 with one or more risk factors for stroke.

**Conclusions:** While stroke is a devastating disease, increasing physician and patient awareness, and knowing accepted treatment modalities, the risk can be reduced significantly.

### **INTRODUCTION**

Stroke is a devastating disease that not only affects patients (along with their friends and relatives) but on a larger scale, the economy. Stroke falls into two broad categories: ischemic and hemorrhagic. Hemorrhagic stroke has two subtypes: subarachnoid and intracerebral. Ischemic stroke includes thrombotic and embolic types. Generally, ischemic stroke accounts for 80% and hemorrhagic stroke for 20% of all such events.

Each year there are approximately 500,000 cases of stroke of which 150,000 are fatal.<sup>1</sup> Often, patients are left with physical disabilities as well as mental impairment. There are over 3 million living post-stroke patients in the United States today.<sup>2</sup> The direct and indirect cost for providing care to these patients is estimated at \$41 billion per year.<sup>3</sup> Currently, there are no widely accepted treatments for most forms of stroke. However, the American Heart Association estimates that preventive care can reduce the risk of stroke by 80%.<sup>4</sup>

The basis of prevention is the treatment of contributing risk factors: hypertension, diabetes, atrial fibrillation, tobacco use, alcohol intake, hypercholesterolemia and obesity.<sup>4</sup> Despite all that the medical community knows about stroke, patients are largely unaware of the warning signs. A recent Gallop Poll reported that individuals within the United States could not identify a single warning sign of stroke.<sup>5</sup> Therefore, in addition to the treating and modifying contributing conditions, patient awareness and education are also important.

## METHODS

It is important to understand why we should prevent stroke. First, stroke is the primary cause of nursing home confinement and long-term disability among adults.<sup>4</sup> More than 40% of these patients suffer debilitating sequelae such as speech difficulties, decreased mobility, impaired cognition, sensory losses and depression.<sup>6</sup> Estimates run as high as 50% of stroke victims dying within one year of the event.<sup>7</sup> Within 5 years, one third of the patients who experience a stroke will experience another.<sup>8</sup> With 500,000 cases of stroke each year and 3 million living stroke victims, the direct and indirect treatment costs run as high as 41 billion dollars per year.<sup>9</sup> Fortunately, stroke is largely preventable.

Transient ischemic attacks (TIA's) indicate the presence of cerebral vascular disease and impending cerebral vascular accident. Approximately 50% of all patients who develop a stroke have a TIA; these patients should be identified quickly and worked up as potential stroke victims.<sup>4</sup> TIA's are brief episodes of neurologic dysfunction that last between 2 to 15 minutes and completely resolve in less than 24 hours without long-term sequelae<sup>10</sup> or any acute memory loss.<sup>4</sup> In addition to a thorough history and physical examination, the work-up should include computed tomography, clotting studies, electrocardiogram (ECG), carotid and cardiac Doppler studies<sup>4</sup>, blood chemistries and a CBC. Of note, a carotid bruit appears only to be a positive predictor of stroke in approximately 60-70% of patients.<sup>10</sup>

The risk factors for stroke are well known. The unmodifiable risk factors include gender, race, age and family history. Men are at 50% greater risk than women<sup>11</sup>; the risk of stroke is also 50% greater and more severe in the African-American population.<sup>11</sup> Next, the risk of stroke doubles every decade after the age of 55 with 70% occurring in people over the age of 65.<sup>12</sup> Despite that, 28% of strokes occur in people under the age of 65 and women account for 40% of new strokes.<sup>13</sup>

Potentially modifiable risk factors include hypertension, atrial fibrillation, smoking, diabetes, hypercholesterolemia, alcohol abuse and obesity. Other risk factors may be considered such as ECG or echocardiographic evidence of left ventricular hypertrophy (LVH) "Strain" pattern on ECG, left ventricular dysfunction, and coronary artery disease.<sup>14</sup>

The Family Medicine Center hopes to reduce the risk for stroke through physician awareness, patient education and appropriate intervention. By reinforcing knowledge of the risk factors for stroke and identifying those patients at greatest risk, this can be accomplished. Using the following categories, FMC physicians may be better able to take preventative action.

### Hypertension

Hypertension is a factor in nearly 70% of all strokes.<sup>15</sup> It is the most closely associated risk factor. A recent combined meta-analysis studied the benefit of blood pressure reduction on the incidence of stroke. The result revealed a 42% reduction in the incidence of stroke and a 45% reduction in the incidence of fatal stroke.<sup>16</sup> In addition, isolated hypertension (systolic blood pressure > 160 mm Hg, and diastolic blood pressure < 90 mm Hg) was studied. The Systolic Hypertension in the Elderly Program correlated a reduction of 11mm Hg in mean systolic blood pressure and a 3.4 mm Hg reduction in mean diastolic pressure with a 36% stroke reduction.<sup>17</sup> With such compelling evidence for therapy, hypertension should no longer be considered part of the natural aging process.

## **Smoking**

Cigarette smoking is a major cause of both ischemic and hemorrhagic stroke.<sup>18</sup> Smoking is associated with hypertension,<sup>19</sup>, atherosclerosis,<sup>20</sup>, and increased hematocrit levels.<sup>21</sup> It is also associated with increased levels of clotting factors,<sup>22</sup> platelet aggregability,<sup>23</sup> and decreased levels of high-density lipoprotein cholesterol.<sup>24</sup> Moreover, smoking cessation lowers the relative risk of stroke to the level of non-smokers after 2-5 years.<sup>25 26</sup> Tobacco cessation should be strongly and frequently encouraged.

## **Diabetes**

Diabetes is associated with coronary artery disease, hypertension and hypercholesterolemia.<sup>27</sup> The disease has been linked to stroke as well.<sup>28 29 30</sup> Ninety percent of diabetics have non-insulin dependent diabetes mellitus. Therefore, the key to controlling this disease revolves around diet, exercise and weight loss. Euglycemia may reduce the relative risk of stroke estimated between 1.8-3.0 in diabetics.<sup>18</sup> However, the benefit of strict glycemic control remains uncertain.

## **Hypercholesterolemia**

Although there is clear evidence of an association between hypercholesterolemia and coronary artery disease, the relationship with stroke is not as certain. There appears to be a direct association between total serum cholesterol and ischemic stroke. However, there is an inverse relationship with hemorrhagic stroke.<sup>18</sup> The proposed link between ischemic stroke and total serum cholesterol has not been consistently observed.<sup>28 31 32</sup> For those patients with or at risk for developing CAD, it seems appropriate to adopt the National Cholesterol Education Program guidelines for this condition. Continued study of the association between stroke and cholesterol must be performed before recommendations can be confidently given.

## **Obesity**

One third of all adults in the United States are considered obese with the prevalence increasing.<sup>33</sup> Furthermore, there is an association between obesity and hypercholesterolemia, diabetes and hypertension.<sup>34</sup> For all stroke types, the population attributable risk due to obesity is between 15-25%.<sup>18</sup> Also, there is an inverse relationship between physical activity and the risk of stroke in men and women.<sup>35-38</sup> Therefore, by encouraging obese patients to adhere to lifestyle changes such as increased exercise and decreased caloric and fat intake the risk of stroke can be reduced.

## **Alcohol**

There appears to be a dose dependent relationship between alcohol consumption and hemorrhagic stroke with increased risk even at low levels.<sup>18</sup> At low levels of alcohol consumption (1-2 drinks per day) the risk of ischemic stroke is reduced. The relative risk increases to 2 for persons consuming three or more drinks per day.<sup>18</sup> The mechanisms by which moderate alcohol consumption reduces the risk of stroke include the reduction in the risk of coronary artery disease,<sup>39</sup> modification of blood lipid levels,<sup>40</sup> and inhibition of clotting.<sup>41</sup> Considering the overall health risk of alcohol consumption, and the increased risk of hemorrhagic stroke at even low levels of alcohol consumption, mild to moderate consumption of

alcohol should not be recommended as a preventive measure. The relation between moderate alcohol consumption to the risk of ischemic stroke has not been conclusively determined.<sup>18</sup>

### **Atrial Fibrillation**

Atrial Fibrillation (AF) causes blood stasis within the atria which may lead to thrombus formation and systemic embolic events. Hypertension is the most common cause, but congestive heart failure and rheumatic heart disease contribute.

Approximately 80,000 of the 500,000 strokes each year are due to complications from atrial fibrillation.<sup>42</sup> The risk of stroke with atrial fibrillation is 5 times higher than with a normal sinus rhythm; that risk being compounded by any additional risk factors.<sup>43</sup>

Ideally, an attempt should be made to convert the patient back into a normal sinus rhythm, but other considerations exist. First, for all patients in a new-onset AF, thyroid function tests should be performed to rule out thyrotoxicosis. For patients who fail cardioversion, a recent meta-analysis of the pooled data from 6 stroke prevention studies found a 64% reduction in stroke among patients on coumadin.<sup>44</sup> Also, aspirin has been shown to reduce risk by 20-25%.<sup>45</sup> However, if the patient cannot tolerate aspirin, Ticlid, also a platelet inhibitor, is another option. Stroke due to atrial fibrillation is largely preventable.

### **Carotid Endarterectomy (CEA)**

Surgical correction of carotid artery stenosis is reserved for those with a recent TIA or minor stroke who have a 70-99% stenosis and for asymptomatic patients with a 60% or greater stenosis.<sup>46</sup>

Noninvasive assessment of carotid artery stenosis may have both the sensitivity and specificity needed to assess carotid artery stenosis at the lowest cost.<sup>47</sup> To eliminate morbidity associated with cerebral angiography some have suggested proceeding to surgery based upon carotid Doppler and duplex ultrasonography.<sup>48-50</sup>

The Veterans Administration Cooperative Study found a 38% risk reduction for the combined endpoints of ipsilateral TIA, transient monocular blindness, and stroke over 4 years for patients who received endarterectomy.<sup>57</sup> However, the benefits of CEA will be apparent only if perioperative morbidity and mortality are kept at 3% or less.<sup>51</sup>

## **FAMILY MEDICINE CENTER CONTINUING QUALITY IMPROVEMENT**

The Family Medicine Center (FMC) is an ambulatory residency clinic with approximately 2500 active patients. A chart review was performed on FMC patients 55 years and older for stroke risk factors. Secondly, a literature review was conducted to compile recent data and recommendations on the prevention of stroke.

Identifying those patients at risk for stroke and summarizing the data on stroke prevention is the basis of this CQI. FMC physicians can educate both themselves and their patients with these guidelines for stroke prevention through risk factor modification.

148 active patients, ages 55-94, were found to be at risk for stroke. The risk factors considered were hypercholesterolemia, hypertension, diabetes mellitus, atrial fibrillation and coronary artery

disease. Of the 148, 41 had two risk factors, 7 had 3 risk factors and 1 patient had four risk factors. The most common risk factor was hypertension (119 patients) followed by diabetes (43 patients).

## CONCLUSION

Stroke is a devastating disease and the consequences are far-reaching. Not only do patients suffer, but also family and friends of stroke victims. On a larger scale so does the economy. Yet stroke is preventable for the most part. Through both physician and patient awareness, and risk factor modification, the likelihood of stroke can be significantly reduced.

## REFERENCES

1. Heart and stroke facts. Dallas: American Heart Association, 1991
2. Heart and stroke facts. Dallas: American Heart Association, 1992
3. National Stroke Association. Cost of Stroke. *Stroke Clinic Updates* 1994 pp 5:9-12
4. Fink ME: Warning symptoms for stroke. *Newsweek* 1996; 127:S18-S20
5. McBride G. Stroke: a prevention and survival kit. *American Health* 1995; 14:64-69
6. Janowski MJ: A road map for stroke recovery. *RN* 1996;59:26-30
7. Hagen M: AHCPR post stroke rehabilitation guideline. *AM Fam Physician* 1995;52:404-406
8. LaBorde K: Strokes: detecting, preventing and dealing with them. *New Orleans Magazine* 1995;29:78-80
9. Strokes cost \$41 billion a year researchers find. *The New York Sunday Times*, January 28, 1996;S1:10,22
10. Santilli JD, Santilli SM, Rodnick JE: Prevention of stroke caused by carotid bifurcation stenosis. *Am Fam Physician* 1996;53:549-560
11. Gresham GE, Duncan PW, Stason WB, et al : Post-Stroke Rehabilitation. Clinical Practice Guideline Number 16. AHCPR Publication No. 95-0662. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services, May 1995
12. American Heart Association: Heart and Stroke Facts and Statistics, 1993. Dallas: American Heart Association, 1993
13. Stroke Facts. Dallas: American Heart Association, 1988
14. Oddone EZ, Matchar DB, et al : Stroke Prevention in a 75-year old asymptomatic patient. *Hospital Physician* 1996; 32:35-48

15. Dunbabin DW, Sandercock PAG: Preventing stroke by the modification of risk factors. *Stroke* 1990;21;Suppl IV:IV-36-39
16. MacMahon S, Peto R, Cutler J, et al : Blood pressure, stroke and coronary heart disease. Prolonged differences in blood pressure: prospective observational studies corrected for the Regression dilution bias. *Lancet* 1990;335:765-74
17. SHEP Cooperative Research Group.: Prevention of stroke by antihypertensive drug treatment in older persons with isolated systolic hypertension: final results of the Systolic Hypertension in the Elderly Program (SHEP). *JAMA* 1991;265:3255-64
18. Bronner LL, Kanter DS, Manson JE: Primary prevention of stroke. *NEJM* 1995;21:1392-1400
19. Kubota K, Yamaguchi T, Abe Y, Fugiwara T, Hutazawa J, Matsuzawa T: Effects of smoking on regional cerebral blood flow in neurologically normal subjects. *Stroke* 1983;14:720-4
20. Sieffert GF, Keown K, Moore WS: Pathologic effect of tobacco smoke inhalation on arterial intima. *Surg Forum* 1981;32:333-5
21. Smith JR, Landaw SA: Smokers' polycythemia. *NEJM* 1978;298:6-10
22. Wilhelmsen L, Svardsudd K, Korsan-Bengsten K, Larsson B, Welin L, Tibblin G: Fibrinogen as a risk factor for stroke and myocardial infarction. *NEJM* 1984;311:501-5
23. Renaud S, Blache D, Dumont E, Thevenon C, Wissendanger T: Platelet function after cigarette smoking in relation to nicotine and carbon monoxide. *Clin Pharmacol Ther* 1984;36:389-95
24. Criqui MH, Wallace RB, Heiss G, Mishkel M, Schonfeld G, Jones GT: Cigarette smoking and plasma high-density lipoprotein cholesterol: the Lipid Research clinics Program Prevalence Study. *Circulation* 1980;62:Suppl IV:IV-70—IV-76
25. Wolf PA, D'Agostino RB, Kannel WB, Bonita R, Belanger AJ: Cigarette smoking as a risk factor for stroke: The Framingham Study. *JAMA* 1988;259:1025-9
26. Kawachi I, Colditz GA, Stampfer MJ, et al : Smoking cessation and decreased risk of stroke in women. *JAMA* 1993;269:232-6
27. American Diabetes Association. Role of cardiovascular risk factors in prevention and treatment of macrovascular disease in diabetes..*Diabetes Care* 1989;12:573-9
28. Wolf PA, Cobb JL, D'Agostino RB: Epidemiology of stroke. In: Barnett HJM, Mohr JP, Stein BM, Yatsu FM, eds. *Stroke: pathophysiology, diagnosis and management*. 2<sup>nd</sup> ed. New York Churchill Livingstone. 1992:3-27
29. Burchfiel CM, Curb JD, Rodriguez BL, Abbott RD, Chiu D, Yano K: Glucose intolerance and and 22-year stroke incidence: the Honolulu Heart Program. *Stroke* 1994;25:951-7

30. Manson JE, Colditz GA, Stampfer MJ, et al : A prospective study of maturity-onset diabetes mellitus and risk of coronary heart disease and stroke in women. *Arch Intern Med* 1991;151:1141-7
31. Paffenbarger RS Jr., Hyde RT, Wing AL: Physical activity and physical fitness as determinants of health and longevity. In: Bouchard C, Shephard RJ, Stephens T, Sutton JR, McPherson BD, eds. *Exercise, fitness and health: a consensus of current knowledge*. Champaign, Ill.: Human Kinetics Books, 1990:33-48
32. Benfante R, Yano K, Hwang LJ, Curb JD, Kagan A, Ross W: Elevated serum cholesterol is a risk factor for both coronary heart disease and thromboembolic stroke in Hawaiian Japanese men: implications of shared risk. *Stroke* 1994;25:814-20
33. Kuczmarski RJ, Flegal KM, Campbell SM, Johnson CL: Increasing prevalence of overweight among U.S. adults: the National Health and Nutrition Examination Surveys, 1960 to 1991. *JAMA* 1994;272:205-11
34. National Research Council. Diet and health: implications for reducing chronic disease risk. Washington D.C.: National Academy Press, 1989.
35. Abbott RD, Rodriguez BL, Burchfiel CM, Curb JD: Physical activity in older middle-aged men and reduced risk of stroke: the Honolulu Heart Program. *Am J Epidemiol* 1994;139:881-93
36. Wannamethee G, Shaper AG: Physical activity and stroke in British middle aged men. *BMJ* 1992;304:597-601
37. Kiely DK, Wolf PA, Cupples LA, Beiser AS, Kannel WB: Physical activity and stroke risk: the Framingham study. *Am J Epidemiol* 1994;140:608-20
38. Manson JE, Stampfer MJ, Willett WC, et al :Physical activity and incidence of coronary heart disease and stroke in women. *Circulation* 1995; 91:927 abstract
39. Moore RD, Pearson TA: Moderate alcohol consumption and coronary artery disease: a review. *Medicine (Baltimore)* 1986;65:242-67
40. Camargo CA Jr, Williams PT, Vranizan KM, Albers JJ, Wood PD: The effect of moderate alcohol intake on serum apolipoproteins A-I and A-II: a controlled study. *JAMA* 1985;253:2854-7
41. Jakubowski JA, Vaillancourt R, Deykin D: Interaction of ethanol prostacyclin, and aspirin in determining human platelet reactivity in vitro. *Arteriosclerosis* 1988;8:436-41
42. Wolf PA, Abbott RD, Kannel WB: Atrial fibrillation: a major contributor to stroke in the elderly: the Framingham study. *Arch Intern Med* 1987;147:1561-1564
43. Matchar DM, McCrory D, Barnett H, Feussner JR: Medical treatment for stroke prevention *Ann Intern Med* 1994;121:41-53
44. Morley J, Marinchak R, Riais SJ, et al : Atrial fibrillation, anticoagulation and stroke. The *Am J Cardiology* 1996;77:38A-44A

45. Albers GW: Atrial fibrillation and stroke: three new studies, three remaining questions. *Arch Intern Med* 1994;154:1443-1448
46. North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. *NEJM* 1991;325:445-453
47. Blakely DD, Oddone EZ, Hasselblad V, et al: Noninvasive carotid artery testing. A meta-analytic review; *Ann Intern Med* 1995;122:360-367
48. Balas P, Pagratis N, Massouridou E, Ioannou N: Is cerebral arteriography necessary for decision making in carotid endarterectomy? *Int Angiol* 1991;10:213-216
49. Gelabert HA, Moore WS: Carotid endarterectomy without angiography. *Surg Clin North Am* 1990;70:213-223
50. Patel MR, Kuntz KM, Klufas RA, et al : Preoperative assessment of the carotid bifurcation Can magnetic resonance angiography and duplex ultrasonography replace contrast arteriography? *Stroke* 1995;26:1753-1758
51. Rothrock JF: Recent advances in stroke prevention and treatment. *Family Practice Recertification* 1997;19:13-29